Factors Associated with Short Term Outcomes of Hypospadias Repair at the University Teaching Hospitals-Lusaka, Zambia

Kalota Seith[1], Nenad Spasojevic[2], Bvulani Bruce[3]

[1]UniversityTeachingHospital, Department of Surgery, Pediatric and Neonatal surgery unit, P/BRW1X, Lusaka, Zambia

[2]UniversityTeachingHospital, Department of Surgery, Urology unit II, P/BRW1X, Lusaka, Zambia[3]UniversityTeachingHospital, Department of Surgery, Pediatric and Neonatal surgery unit, P/BRW1X, Lusaka, Zambia

Address of Correspondence:

Dr.Kalota Seith; UniversityTeachingHospital,Department of Surgery, Paediatric and Neonatal unit, P/BRW1X,Lusaka,Zambia.Telephone:260967025779;E-mail: kalotaseith@gmail.com

DOI: 10.53974/unza.jabs.5.2.688

ABSTRACT

Introduction: the study aimed to establish whether age at the time of surgery, glans size, urethral plate width, suture material, urethral catheter blockage or dislodgement and haemoglobin level influence short term outcomes of hypospadias surgery at the University Teaching Hospitals (UTH), in Lusaka in Zambia.

Materials and Methods: This was a consecutive (total enumerative) observational cohort study done at D-block and Clinic 7 at UTH in Lusaka over nine months. A total of 41 patients were enrolled, and their demographic data, haemoglobin, maximum glans width size and urethral plate size before creating glans wing or midline plate incision were noted and measured. Logistic regression assessed urethroplasty complications on urethral plate size, glans size, haemoglobin, suture material and catheter problems.

Results: The average age of participants was 34 months. Distal hypospadias was the most common type at 61 per cent while middle hypospadias was 27 per cent and proximal hypospadias 12 per cent. The complication rate was 34 per cent. The most common complication seen was urethrocutaneous fistula at 53 per cent. The other complications seen included 11.8 per cent glanular dehiscence, 11.8 per cent infections, 6 per cent persistent chordee and 6 per cent penile torsion. The risk factors for postoperative complications included the location of the urethral opening. The more proximal the site of the hypospadias, the higher the complication rate. Complications were strongly associated with haemoglobin levels of less than 11.5g/dl (p=0.001) and catheter blockage or dislodgment (p=0.008). There was no association of complications with Socioeconomic status, age at the time of repair, glans width size or suture material. Contrary to the finding of many authors, a wider urethral plate in this study was associated with a higher complication rate.

Keywords: *Hypospadias, short term outcomes, complications, complication rate, Urethrocutaneous fistula, glanular dehiscence, persistent chordee, penile torsion*

Introduction

Hypospadias is a congenital anomaly representing a spectrum of deficiency in penile development in which the urethral meatus terminates on the ventral surface of the penis proximal to the normal site,

anywhere from the glans perineum [1]. Implying the urethral opening may be anywhere along the ventral penile shaft, within the scrotum or on the perineum. The incidence of hypospadias is 1 per 250 live male births [2].

Hypospadias affects children in many ways; firstly, the affected patients' penis is a cosmetic difference from other children hence psychologically impacting negatively on the patient. Secondly, organic problems, such as the inability to pass urine in a standing position and more importantly is the accompanying subfertility that may ensue in adulthood. In the moderate to severe forms, surgery is advocated to correct this anomaly [1].

Hypospadias surgery is technically demanding and sometimes has complications that include postoperative bleeding, infections, devitalised skin flap, urethrocutaneous fistulae, strictures, diverticula, retrusive, meatus and persistent chordee. Corrective hypospadias surgery in Africa is associated with an unacceptably high complication rate. According to a study titled 'Acute postoperative complications of hypospadias repair' published in the Indian Journal of urology, the acceptable complication rate for distal hypospadias repair should be less than 5 per cent and proximal hypospadias less than 10 per cent [3]. However, studies done in Sudan, Khartoum showed a complication rate of 38 per cent [1], while that in Nigeria, Abuja showed a 50 per cent complication [4].

Surgical treatment outcome is influenced by many postulated factors, including patient factors such as age at the time of repair, type of hypospadias, glans size and urethral plate width, surgical factors such as fine appropriate suture material and instrument factors such as optical magnification and delicate instruments. Most surgeons argue that these are essential determinants in the outcome of hypospadias surgery. The technicality of urinary diversion using stents, Foley's catheters or suprapubic cystostomy cannot be overemphasised [2]. However, suboptimal theatre conditions, lack of delicate instruments, special dressing and suture materials, and high infection rates in some parts of Africa, especially sub-Saharan Africa, make hypospadias repair even more challenging [5]. Locally at UTH, Lusaka, Zambia, the outcome and factors associated with poor hypospadias outcomes have not been studied, hence this study.

MATERIALS AND METHOD

This observational cohort study was conducted in Pediatric and Neonatal surgical (D-block) and Urology Units at the University Teaching Hospitals, Lusaka, Zambia. A total of 41 patients were conveniently enrolled in the study. Data was collected using a structured data collection sheet and analysed using STATA version 13. The demographic data, haemoglobin, maximum glans width size and urethral plate size before creating glans wing or midline plate incision were noted and measured. Logistic regression assessed urethroplasty complications (urethrocutaneous fistula, glans dehiscence, infection, penile torsion, persistent chordee) on urethral plate size, glans size, haemoglobin, and suture material and catheter problems.

RESULTS

Baseline demographic characteristics of the study participants

The median age of the participants at the time of hypospadias surgery was 36 months (IQR, 22-60). The mean mother's age to the studied participants

was 25 years with a standard deviation of 6.8 years. Thirty-seven (90%) of the study participants were born at term, 1(2.5%) was preterm, and 3(7.5%) were post-term births. Three mothers (7.3%) had primary education, 23(56.1%) had secondary, and 15(36.6%) had tertiary education. Twenty (48.8%) of the studied participants belonged to low socioeconomic status, while 21(51.2%) to a high socioeconomic status. Thirty-five (85.4%) of mothers to the participants were not exposed to insecticides or pesticides during their pregnancy with the studied participants, while 6(14.6%) were exposed to insecticides or pesticides. Eight (19.5%) had a family history of hypospadias.

Association between complication and baseline demographic characteristics

At the time of surgery, the median age for the participants who had complications was 34 months (IQR, 22-72), and those without complications were 36 months (IQR, 21-60); at p=0.79. The median age for the mothers in the group with complications was 23 years (IQR, 20-33) compared to those without complications, 26 years (IQR, 20-32); at p=0.93 and was not significantly different. There was no significant difference between those that had complications compared to the ones who did not have complications in terms of gestational age (p=0.30), mothers level of education (p=0.10), socioeconomic status (p=0.44), maternal exposure to insecticide/pesticide during pregnancy (p=0.96) and family history (p=0.54).

Baseline clinical characteristics for the 41 study participants

The mean glans size for the participants was 16.3mm (SD, 3.40), the median urethral plate size was 6mm (IQR, 4-7), and the mean haemoglobin was 11.5g/dl (SD 1.20). The types of hypospadias that were operated on included 25(60.9%) distal penile hypospadias, 11(26.8%) mid penile hypospadias and 5(12.1%) proximal hypospadias (penoscrotal hypospadias). Nine (22%) had the presence of chordee. No participant was found to have penile torsion, 1 (2.4%) participant had penoscrotal transposition. Thirty-six (87.8%) were done as single-stage operations, and 5(12.2%) were done as two-staged operations. On 39(95%) participants' urethral catheters alone were used, 2 (5%) suprapubic catheters and urethral stents were used for urinary diversion. Of all the participants, 15(36.6%) had problems with catheters. Of these, 10(24%) had blocked catheters, and 5(12%) pulled out their urethral catheters. Suturing material used for urethroplasties included Vicryl in 25(61%) participants and PDS in 16 (39%). The median time for discharge was 14days (IQR, 7-14).

Types of hypospadias seen during the study

The types of hypospadias that were seen are coronal 5(12%), subcoronal 20 (49%), mid penile 11(27%), proximal penile 1(2%) and penoscrotal 4(10%). For purposes of meaningful data analysis, these were further categorised as distal (anterior), 25(61%), middle 11(27%) and proximal hypospadias (posterior) 5(12%).

Short-term hypospadias complications were seen during the study.

Following hypospadias repair of 41 patients, 14(34%) developed complications. Three had more than one complication among the 14 patients that developed complications. The first one had meatal

stenosis with an urethrocutaneous fistula, the second had an infection with a urethrocutaneous fistula, and the third had an infection with glanular dehiscence. Thereby leading to the following complications, 9(53%) urethrocutaneous fistulae, 2(11.8 %) glanular dehiscence, 2(11.8. %) meatal stenosis, 2(11.8%) infections, 1(6%) persistent chordee and 1(6%) penile torsion.

Age at time of hypospadias repair and complications

There was no statistical difference in age at the time of hypospadias repair for the studied participants that developed complications and those that did not. Furthermore, there was no statistical difference in complications between studied participants less than 18 months and those above 18 months at the time of surgical repair.

Haemoglobin and complications

There was a significant difference in haemoglobin levels between patients who developed complications (who has median haemoglobin of 11g/dl [IQR, 10.0-12.2]) compared to patients that did not develop complications (who had median haemoglobin of 12.3 g/dl [IQR, 11.6-13.0]; p=0.005. There was a significant statistical association between patients with haemoglobin less than 11.5g/dl and complications (p=0.001). Patients with haemoglobin less than 11.5g/dl had 11(61%) patients with complications compared to those with more than 11.5g/dl who had 3 (13%) developing complications. There was an increased association of developing complications with less than 11.5g/dl with haemoglobin.

Problems with a catheter (urinary diversion) and complications

Problems with a catheter (urinary diversion) were defined as patients whose urethral catheters either got blocked or was pulled out by the study participants. There was a significant statistical association between studied participants who had catheters and complications (p=0.008). There was an increased number of complications with people with catheters than those who did not. After adjusting for other variables, the probability of developing complications when the patient had a catheter problem was much higher than one who did not. In this analysis, the odds of developing complications when one had a catheter problem were 6 times compared to 2 when one did not have catheter problems.

Urethral plate width size and complications

There was a statistical difference in urethral plate width in patients with complications and those who did not (p=0.01). Patients with complications had a median urethral plate width of 7mm (IQR, 5-11); those without had a median urethral plate of 5mm (IQR, 4-7).

Comparison of complications between patients with urethral plate width size <8mm and >8mm

The patients with urethral plate width < 8mm were 31. Seven (23%) developed complications. On the other hand, those with urethral plate width > 8mm were 10 and 7(70 %) of these developed complications. Therefore the complication rate for patients with a urethral plate width size of less than 8mm was 23 per cent, while that for those with a urethral plate size greater than 8mm was 70 per cent.

After adjusting for other variables, the adjusted predictions of the socioeconomic status with a 95 per cent confidence interval, the probability of developing a complication with a urethral plate width of more than 8mm were higher than when the urethral plate width was less than 8mm.

Glans width size and hypospadias repair complication

There was no statistical difference in glans width size between the groups with complications (who had a median glans width of 16 mm [IQR, 14 -18]) and those without complications (who had a median glans width of 17mm [IQR, 13-19]); at p=0.43). Furthermore, there was no statistical (p=0.80) difference in complications between patients with glans width greater than 14mm and less than 14mm. After adjusting for other variables, the predictive margins of social and economic status showed that the probability of developing complications reduces with increasing glans size.

Association between complications and clinical characteristics

There was a significant association between complications and type of hypospadias (p=0.003), problem with a catheter (p=0.008) and UCF resolution (p<0.001)).

Correlation matrix among independent variables

There was a significant and positive correlation between the type of catheter and urethral plate size (r=0.48; p<0.001) and between haemoglobin and problem with a catheter (r=0.60, p<0.001), as shown in Table 1.

Multivariable logistic regression analysis

When a univariate regression model was constructed, every one unit increase in haemoglobin level was significantly associated with a 33 per cent reduction in complications. After adjusting for baseline demographic characteristics in multivariable regression, the reduction in complications was 26 per cent, p =0.03. An increase in glans width and urethral plate width size was protective against complications but were not significant. Having problems with the catheter was associated with 2.91 odds of developing complications in the univariate analysis, which reduced to 1.54 odds in the multiple regressions but was not significant. Having any type of hypospadias (proximal or mid penile) was associated with increased complications compared to distal type but was not significant (Table 2).

DISCUSSION

Individual types of hypospadias seen during the study included 12 per cent coronal, 49 per cent sub coronal, 27 per cent mid penile, 2 per cent proximal penile and 10 per cent penoscrotal hypospadias. From the distribution of various types of hypospadias, sub coronal hypospadias was the most common type of hypospadias seen at UTH, and it accounted for 49 per cent of hypospadias. However, for meaningful data analysis, this was further categorised into three (3): distal penile, middle and proximal hypospadias. This is the favoured classification of most authors and is based on the locations of the hypospadiac meatus after repair of the chordee (orthoplasty). Using this classification, 61 per cent of the hypospadias seen were distal, 27 per

cent were middle, and 12 per cent were proximal hypospadias. Campbell *et al.* [6], and Coran and Adzick [7], discussed the occurrences of distal hypospadias to be 50 per cent to 70 per cent of the entire spectrum of hypospadias, while middle hypospadias is 30 per cent and proximal hypospadias is 20 per cent. Aschcraft *et al.* [2] described distal hypospadias as the most common type at 52 per cent, proximal hypospadias at 31.7 per cent, and middle hypospadias at 16.3 per cent. Abdelrahman *et al.* [1], also found distal hypospadias to be the most common type with 40 per cent. Our findings were comparable with these studies because distal hypospadias was the most common type. However, the proximal type of hypospadias seen in the study accounted for only 10 per cent of the hypospadias and was lower than others reported, as shown above. Therefore, this suggests that UTH sees fewer proximal hypospadias numbers than other centres.

The total number of patients enrolled in the study was 41 males. At the time of operation, the ages ranged from 22 months to 60 months, with a medium age of 36 months. This finding was similar to a study conducted by Abdelrahman *et al.* [1] in Sudan, where more than 50 per cent of patients were operated on at a mean age of 36 months. However, this is different from a study conducted by Aisodione Shadreck *et al.* [l4] in Nigeria, where the mean age of the patients at operation was 44.9 months.

The study by Aisodione Shadreck *et al.* [4], on the contrary, showed that 54 per cent were of low socioeconomic status. Olajide *et al.* [8] of Nigeria, in their study of the Ile-Ife, found that 90 per cent of the hypospadias were from low socioeconomic status. The difference may be that these studies were done in lower socioeconomic status regions of Nigeria; therefore, most patients were tagged as coming from low socioeconomic status. A study conducted in Finland on geographic differences in the prevalence of hypospadias showed no association of hypospadias with social class [9]

About 19.5 per cent had a family history of hypospadias from this study. Ashcraft *et al.* [2] also found a 19 per cent family history in an index child with a second-degree relative. Margot *et al.* [10] found a family history of 23 per cent. Jason Lee *et al.* [11] write that 14 per cent of male siblings of affected boys have hypospadias. The findings in this study had a slightly higher percentage of family history than most of the above-quoted studies. However, they compare relatively well with them.

The overall complication rate of hypospadias seen during the study was 34 per cent. The most common complication seen was urethrocutaneous fistula accounting for 53 per cent of complications, followed by glanular dehiscence at 11.8 per cent, meatal stenosis at 11.8 per cent, infection at 11.8per cent, and persistent infection chordee and penile torsion accounting for 6 per cent. In his study, Salem *et al.* [12] in Egypt showed that the most common complication was an infection. A study by Wilkinson *et al.* [13] conducted in England showed that the urethrocutaneous fistula complication rate was 8.1 per cent, meatal stenosis at 2.3 per cent and urethral stricture at 1.8 per cent. This spread difference shows that various centres have different aspects of hypospadias surgery requiring extra attention.

The study showed no difference in the complication rate with regards to

the age at the date of operation. This finding was similar to that of Snodgrass and Bush [14] who emphasised that speculations made by other surgeons, which state that increased age at the time of repair increases urethroplasty complications, was not borne in their surgical study experience. Therefore, pre-puberty boys of varying ages have the exact expectations of urethroplasty complications as those at any age. This conclusion was also found by Osifo and Mene [15], Hayashi and Kojima [16]. However, contrary findings by Aisodione-Shadreck *et al.* [4] in Nigeria showed that age at the time of surgery had a high complication rate of 50 per cent, suggesting that hypospadias repair at an older age is associated with complications.

It has become acceptable that early hypospadias repair is desirable as it is evidence that healing may be better with reduced inflammatory factors and less scaring on the patient. Over the past few decades, technical advances have made it possible to repair hypospadias in the first six months. Manley and Epstein [17] reported reduced patient anxiety when the repair was carried out before eighteen (18) months. At this age, anaesthesia associated risks are no more significant than in adults. The findings of this study suggest that most of our patients present late. Having no increased risks of complications, whether surgery is done at an earlier or later age, makes this valuable information in planning for surgery at UTH.

The study showed a significant association between types of hypospadias and complications. Proximal hypospadias had the highest complication rate of 60 per cent. Middle hypospadias had a complication rate of 36 per cent, and distal hypospadias had the least complication rate of 20 per cent. Similarly, Snodgrass and Bush [14], Abdelrahman *et al.* [1] consistently agree that the highest complications lay among proximal hypospadias repair. The reasons for the high complication rate in our study may be partly associated with the high rates of catheter problems and low haemoglobin.

Problems with the catheter or urinary diversion were defined as patients who had blocked catheters or catheters pulled out or dislodged by the study participants. Two methods of urinary diversions were used. About 95 per cent of patients used intra-urethral urinary diversion, and the remaining 5 per cent used supra-pubic catheters. Patients on whom supra-pubic catheters were used initially developed a urethrocutaneous fistula. However, prior to completing the study, the fistulas were resolved. Therefore the patients with intra-urethral catheters inadvertently developed more complications. Important to this study is a statistical and clinically significant association between problems with catheters and increased complication ($p=0.0005$). Aschraft *et al.* [2] stated that, in theory, urinary diversion should decrease complications and problems with stents becoming plugged or dislodged.

Further, Hardwicke *et al.* [18], besides having similar findings with Aschraft *et al.* [2] elucidated that silicone catheters had an increased association with catheter problems (blockage, infection, bladder spasms) and complications. Demirbilek *et al.* [19] had similar findings as Hardwick [18]. He further found that suprapubic catheter was associated with fewer complications than intra-urethral catheters. However, Aschraft *et al.* [2], McCormack *et al.* [20] and

De Badiola *et al.* [21] observed that problems with the stent becoming blocked or dislodged are uncommon and urinary diversion should decrease complications. These splitting views from the above-cited literature maybe because Hardwicke *et al.* [18] showed increased complications. After all, he used silicone cuffed catheters in his study, while McCormack *et al.* [20] and De Debadiola *et al.* [21] used non cuffed silicone stents for urethral stents. However, in this study, catheters used though non-cuffed were non-silicone catheters, which may explain the high complication rate and difference in results. Evidence has shown that non-cuffed silicone catheters have fewer chances of blockage than latex catheters.

The study showed that patients with more complications had a wider urethral plate size and a median width of 7mm (IQR 5-11) compared to those without complications who had a narrower urethral plate size with a median width of 5mm (IQR 4-7mm). Furthermore, stratifying patients based on width showed that patients with urethral width size smaller than 8 mm had fewer complications than those with urethral plate width size greater than 8mm. Therefore, the odds of developing complications increased with increasing urethral plate size. This was profoundly statistically significant. Nguyen *et al.* [22] showed that there is no statistical difference in outcome with the different plate sizes. Snodgrass and Bush [14] published similar findings. However, Sarham *et al.* [23] showed contrary findings and suggested that a urethral plate bigger than 8mm is associated with successful hypospadias repair. The difference in the quoted studies may be partly because the group that showed no difference in outcome only included the distal type of hypospadias repair, which in itself has a good outcome. For instance, Nguyen *et al.* [22] only included distal type of hypospadias, and this may be the reason his study could not show any difference. Sarham *et al.* [23] included in their study the three (3) types of hypospadias and probably was able to show that urethral plate size was associated with complications. The findings differ from the above-cited studies, as this could have been a surgeon dependent factor. Surgeons are more meticulous with hypospadias repair once they notice the plate size width is narrow. This may explain the good outcome seen in patients with a narrower urethral plate. Besides this, the patients with wider urethral plates are the older children who are more combative when managing their catheters and wounds.

The study did not find any association between glans size and complication. Patients with a glans size bigger than 14mm had comparable complications with those with a glans size of less than 14mm. Faasse *et al.* [24] showed similar findings that there is no statistical association between glans size and urethroplasty complications. Contrary to this, Snodgrass and Bush [14] showed that patients with a glans size smaller than 14mm had a 75 per cent chance of urethroplasty complications under the same conditions. The difference in the cited literature could be that Faasse *et al.* [24] used testosterone cream pre-operatively while Snodgrass and Bush [14] did not use testosterone cream. However, the discordance in results between the studies and this study remains speculative and may imply that more research on this matter is required or that this study may not have been powered enough to bring

out statistical significance regarding glans size.

Conclusion

The most common type of hypospadias seen at UTH is distal hypospadias. At the same time, proximal hypospadias had the highest complication rate. The hypospadias, problems with a catheter (urinary diversion) and low haemoglobin are the main factors associated with short term complications of hypospadias repair. The following recommendations come from this study:

1. The use of silicone catheters as opposed to non-silicone catheters must be encouraged to improve catheter problems. The use of suprapubic catheters may have lesser chances of blocking and dislodgment.
2. As can be seen from this study that a significant number of patients had problems with urethral catheters, a follow-up study to compare suprapubic catheters with urethral catheters and ascertain whether Suprapubic catheters would be associated with fewer complications.
3. Hypospadias repair should be done when haemoglobin levels are 12g/dl and above.
4. Surgeons should assess for malnutrition and albumin levels before surgery to know the cause of low haemoglobin in the hypospadias patients.

References

1. Abdelrahman MYH, Abdeljaleel IA, Mohamed E, Bagadi A-TO, Khair OEM. Hypospadias in Sudan, clinical and surgical review. Afr J Paediatr Surg AJPS. 2011 Dec;8(3):269–71.
2. Ashcraft KW, Holcomb GW, Murphy JP, Ostlie DJ, editors. Ashcraft's pediatric surgery. Sixth edition. London ; New York: Saunders/ Elsevier; 2014. 1165
3. Bhat, A., Mandal, A.K., 2008. Acute postoperative complications of hypospadias repair. Indian J. Urol. IJU J. Urol. Soc. India 24, 241–248.
4. Aisuodionoe-Shadrach OI, Atim T, Eniola BS, Ohemu AA. Hypospadias repair and outcome in Abuja, Nigeria: A 5-year single-centre experience. Afr J Paediatr Surg AJPS. 2015 Mar;12(1):41–4.
5. Lopes, J.F., Schned, A., Ellsworth, P.I., Cendron, M., 2001. Histological analysis of urethral healing after tubularized incised plate urethroplasty. J. Urol. 166, 1014–1017.
6. Wu, V.K., Poenaru, D., Poley, M.J., 2013. Burden of Surgical Congenital Anomalies in Kenya: A Population-Based Study. J. Trop. Pediatr. 59, 195–202. https://doi.org/10.1093/tropej/fmt001
7. Coran, A.G., Adzick, N.S., ScienceDirect (Service en ligne), 2012. Pediatric surgery. Elsevier Mosby, Philadelphia, Pa.
8. Olajide O, Sowande AO, Salako AA, Olajide FO, Adejuyigbe O. challenges of surgical repair in Ile-Ife, Nigeria. AJU (African Journal of Urology). 2009 No;15:96–102.
9. Aho MO, Koivisto A-M, Juhani Tammela TL, Auvinen A-P. Geographical differences in the prevalence of hypospadias in Finland. Environ Res. 2003 Jun 1;92(2):118–23.
10. Raftery, A.T., 2008. Applied basic science for basic surgical training. Churchill Livingstone, Edinburgh; New York.
11. Sadler, T.W., Langman, J., 2012. Langman's medical embryology, 12th ed. ed. Wolters Kluwer Health/ Lippincott Williams & Wilkins, Philadelphia

12. Springer, A., van den Heijkant, M., Baumann, S., 2016. Worldwide prevalence of hypospadias. J. Pediatr. Urol. 12, 152.e1–7. https://doi.org/10.1016/j.jpurol.2015.12.002
13. Wilkinson DJ, Green PA, Beglinger S, Myers J, Hudson R, Edgar D, *et al.* Hypospadias surgery in England: Higher volume centres have lower complication rates. J Pediatr Urol. 2017 Oct;13(5):481.e1-481.e6.
14. Snodgrass W, Bush N. Recent advances in understanding / management of hypospadias. F1000 prime Rep. 2014;6:101.
15. Osifo OD, Mene AO. Hypospadias repair in a resource-poor region: coping with the challenges in 5 years. J Pediatr Urol. 2010 Feb;6(1):60–5.
16. Hayashi Y, Kojima Y. Current concepts in hypospadias surgery. Int J Urol. 2008 Aug 1;15(8):651–64.
17. Manley and Epstein
18. Hardwicke J, Jones E, Wilson-Jones N. Optimisation of silicone urinary catheters for hypospadias repair. J Pediatr Urol. 2010 Aug;6(4):385–8.
19. Demirbilek S, Atayurt HF. One-stage hypospadias repair with a stent or suprapubic diversion: which is better? J Pediatr Surg. 1997 Dec;32(12):1711–2.
20. McCormack M, Homsy Y, Laberge Y. "No stent, no diversion" Mathieu hypospadias repair. Can J Surg J Can Chir. 1993 Apr;36(2):152–4.
21. De Badiola F, Anderson K, Gonzalez R. Hypospadias repair in an outpatient setting without proximal urinary diversion: experience with 113 urethroplasties. J Pediatr Surg. 1991 Apr;26(4):461–4; discussion 464-465.
22. Nguyen MT, Snodgrass WT, Zaontz MR. Effect of urethral plate characteristics on tabularised incised plate urethroplasty. J Urol. 2004 Mar;171(3):1260–2; discussion 1262.
23. Sarhan O, Saad M, Helmy T, Hafez A. Effect of suturing technique and urethral plate characteristics on complication rate following hypospadias repair: a prospective randomised study. J Urol. 2009 Aug;182(2):682–5; discussion 685-686.
24. Faasse MA, Johnson EK, Bowen DK, Lindgren BW, Maizels M, Marcus CR, *et al.* Is glans penis width a risk factor for complications after hypospadias repair? J Pediatr Urol. 2016 Aug;12(4):202.e1-5.

25. TABLES AND FIGURES

Table 10: Correlation matrix among independent variable

	Glans size	U. Plate size	Hb	Type of catheter	Problem with catheter	Suture type	Type of hypospadias
Glans size	1.00						
U. Plate size	0.05 0.77	1.00					
Hb	0.23 0.77	0.17 0.28	1.00				
Type of catheter	-0.12 0.45	0.48* <0.001	0.28 0.08	1.00			
Problem with catheter	0.30 0.06	0.16 0.30	0.60* <0.001	0.30 0.06	1.00		
Suture type	0.20 0.21	0.04 0.79	- 0.06 0.73	0.05 0.75	0.22 0.16	1.00	
Type of hypospadias	0.21 0.19	-0.03 0.86	-0.13 0.40	-0.03 0.87	-0.06 0.73	0.08 0.60	1.00

Hb: haemoglobin; U plate size: urethral plate size.

Table 2: Multiple regression analysis of the association between the complications and the clinical predictor variables

	Univariate			Multiple		
Variables	**OR**	**95% CI**	**p-Value**	**aOR**	**95% CI**	**p-Value**
Plate size	0.94	0.72-1.22	0.64	1.00	0.62-1.62	0.10
Glans size	0.90	0.72-1.12	0.33	0.79	0.60-1.03	0.08
Problems with catheter	2.91	0.75-11.4	0.12	1.54	0.2210.8	0.67
Haemoglobin	*0.67	0.20-0.73	0.01	0.74	0.55-0.79	0.03
Type of hypospadias **Distal Mid penile** **proximal**	Ref. 1.47 1.71	 0.33-6.63 0.23-12.55	 0.62 0.60	 1.79 1.22	 0.28-11.49 0.00-15.2	 0.49 0.54
Type of catheter **Urethral SPC**	***	***	***			

***: type of catheter omitted because of collinearity; a OR: adjusted odds ratio; OR: odds ratio CI: confidence interval